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Auditable Safety Analysis

Auditable Safety Analysis for the Decontamination and Dismantlement of the TAN-616 Liquid Waste Treatment Facility

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ABSTRACT

This auditable safety analysis identifies all actual or potential hazards to the workers, the public, or the environment associated with the activities involved with the decontamination and dismantlement (D&D) of the Test Area North Liquid Waste Treatment Facility (TAN-616). This document presents the results of the auditable safety analysis per Management Control Procedure (MCP)-2451, "Safety Analysis for other than Nuclear Facilities," requirements. The removal of tanks V-1, V-2, V-3, V-9, V-13, and V-14, or the removal of the contents of the tanks, is not included in this D&D activity. Tanks V-1, V-2, V-3, V-9, V-13, and V-14 are located outside of the TAN-616 building and are not part of the work scope.

The purpose of the auditable safety analysis is to present a facility description, hazard analysis, and a discussion of the hazard controls that will be used to minimize personnel exposures. The facility description briefly summarizes the facility location, process description, and background and history. The hazard analysis identifies and evaluates the potential hazards associated with the D&D activities that will be conducted at TAN-616. Hazard controls for each of the hazards are described. To prevent and mitigate potential personnel exposure to radiological, nonradiological, and physical hazards at the site, action levels are established in the task-specific health and safety plan (INEEL 2000).

The D&D of TAN-616 is classified as a low-hazard facility per DOE-ID Order 420.D and categorized as a radiological facility based upon guidance in DOE-EM-STD-5502-94 per the *Hazard Assessment for the Decontamination and Dismantlement of the TAN-616 Liquid Waste Treatment Facility* (INEEL 2001d) and approved by United States Department of Energy Idaho Operations Office (Stallman 2001).

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ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AL	action level
ASA	auditable safety analysis
D&D	decontamination and dismantlement
DOE	United States Department of Energy
DOE-ID	United States Department of Energy Idaho Operations Office
HASP	Health and Safety Plan
IET	Initial Engine Test
IH	industrial hygienist
INEEL	Idaho National Engineering and Environmental Laboratory
MCP	Management Control Procedure
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PPE	personal protective equipment
PRD	Program Requirements Document
RCRA	Resource Conservation and Recovery Act
SIH	Standard Industrial Hazard
STD	standard
SWP	safe work permit
TAN	Test Area North
TCE	trichlorethene
TLV	threshold limit value
TSCA	Toxic Substance Control Act
TSF	Technical Support Facility

Auditable Safety Analysis for the Decontamination and Dismantlement of TAN-616 Liquid Waste Treatment Facility

1. INTRODUCTION

This auditable safety analysis (ASA) includes a facility description, hazard analysis, and a discussion of the hazard controls that will be used for the decontamination and dismantlement (D&D) of the Test Area North (TAN)-616 Liquid Waste Treatment Facility.

1.1 Facility Description and Background Information

The D&D activity includes the TAN-616 building and its contents, and also includes the following piping:

- The waste transfer line from TAN-616 to the holding tanks (V-13 and V-14) from a point north of Snake Avenue where the lines will be cut and capped back to the building
- The utility piping (water, steam, caustic, and air) and electrical
- The condensate line from TAN-616 to the warm drain tie-in beneath TAN-615
- The valve pit #1 (TAN-1704) and piping between valve pit #2 and valve pit #1.

The following is not part of the D&D activity:

- Removal of tanks and contents of V-1, V-2, V-3, V-9, V-13, or V-14
- Removal of contents of line 104-A2-6" from V-9.

The TAN-616 building is located in the TAN Technical Support Facility (TSF) area of the Idaho National Engineering and Environmental Laboratory (INEEL). Construction of the 2,000-ft^2 concrete facility was completed in 1955, with process startup in 1958. Figure 1-1 provides the floor plan of the building. Liquid wastes from TAN decontamination processes were treated in the stainless steel evaporator. Condensate and concentrate from the evaporator were collected and stored or disposed of.

Liquid waste from the TAN-607 Hot Shop, Warm Shop, and Decontamination Shop, the Initial Engine Test facility, TAN-615 Actuator Facility, TAN-649 Demineralization Plant, and TAN-633 Hot Cell Annex was collected in three 10,000-gal collecting tanks (V-l, V-2, and V-3) located adjacent to the TAN-616 building; waste flowed from the sump tank (V-9) by gravity to the TAN-616 waste collecting tanks (V-1, V-2, and V-3). Tanks V-1, V-2, V-3, and V-9 are buried east of TAN-616 and stored waste before treatment in TAN-616. During a process run, liquid feed from the collecting tanks was pumped into the head tank (V-5) and flowed from the head tank into the evaporator (V-7). Entrained liquid droplets were separated from the evaporator vapor by the cyclone separator (V-6), and the vapor was condensed in the condenser (E-l). Condensate was held up in the receiver (V-8) and discharged to the TSF-05 injection well. The concentrate remained in the evaporator during a process run allowing its specific gravity to increase. The process was temporarily suspended when the specific gravity reached a set point and the concentrate was educted to the holding tanks (V-13 and V-14). Processing was resumed after the evaporator was emptied.

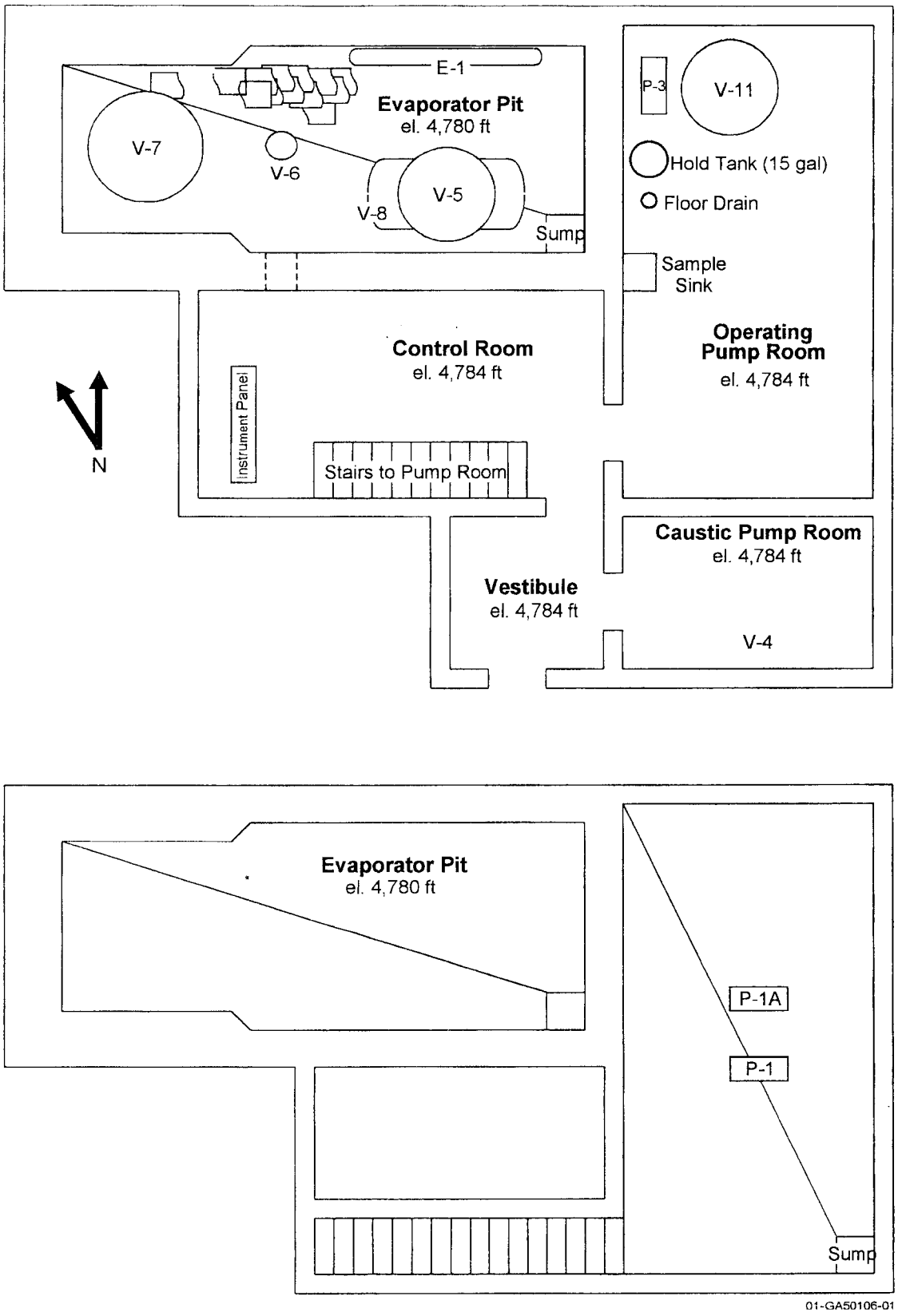

Figure 1-1. TAN-616 floor plan.

The TAN-616 facility operated successfully for several years until the evaporator malfunctioned several times and leaked process solutions to the floor of the evaporator pit. The evaporator leaked due to stress cracks on the bottom of the tank. In 1972, the evaporator process was shut down and the facility was deactivated. In 1993, after removal of the cooling tower, evaporator pit exhaust fan, and stack, a cover was installed above the existing roof to prevent water from entering the building.

1.2 Decontamination and Dismantlement Process Description

The scope of this D&D action includes:

- Sampling and characterization activities for determination of radiological and chemical contamination
- Construction of temporary support facilities
- Preliminary decontamination or fixation of loose contamination
- Removal of all free liquids and sludges from equipment, piping, and pits/sumps
- Removal of friable asbestos-containing materials
- Removal of contaminated equipment, piping, ductwork, structural steel, etc. (includes cutting and capping of piping)
- Removal of roofing and roof access hatches
- Removal of contamination embedded in the concrete floors and walls
- Removal of lead shielding
- Transfer of wastes to appropriate waste storage facility
- The storage of waste materials will also include temporary onsite (TAN-616) storage in cargo containers, roll-off containers, etc.; this includes waste handling and storage activities
- Dismantlement of TAN-616 facility and disposal of materials
- Location of, and removal and/or decontamination of influent and effluent piping
- Confirmation of sampling after dismantlement activities are completed.

The D&D plan (INEEL 2001e) provides a more detailed work scope.

2. HAZARD ANALYSIS

2.1 Hazard Identification and Evaluation Methods

2.1.1 Methodology

The methodology used to identify and evaluate potential hazards to the public, co-located workers, facility workers, and the environment from the D&D of TAN-616 is contained in the following sections.

2.1.1.1 Hazard Identification. A "hazard," as defined by Management Control Procedure (MCP)-2451, is a source of danger (i.e., material, energy source, or operation) with the potential to cause illness, injury, or death to personnel or damage to an operation or to the environment (without regard for likelihood or credibility of accident scenarios or consequence mitigation). To identify potential hazards associated with the D&D of TAN-616, the potential energy sources and initiating events that could result in injury to workers or affect the inventory of radioactive and hazardous materials contained within the facility were identified.

The identification of potential hazards was done by reviewing the operating history of the facility and reviewing existing safety documentation. Characterization activities identified hazardous and radioactive material hazards. Knowledge of how other D&D activities were performed identified potential hazards. Drawings and past operating history also identified potential hazards associated with the D&D of the TAN-616 facility.

A checklist-type analysis was performed for the D&D activities to identify hazards, consider the general types of hazards that may be present, evaluate, in a qualitative fashion, the effects of these hazards, and determine whether the safeguards against these potential hazards appear to be adequate.

2.1.1.2 Hazard Evaluation. Table 2-1 summarizes material and energy source hazards that may be found during D&D activities that could potentially affect the public, workers, or the environment.

Table 2-2 is a checklist that identifies the occupational hazards, including standard industrial hazards, associated with D&D activities and TAN-616, and the United States Department of Energy (DOE)-prescribed occupational safety and health standards that prevent or protect against them. Standard industrial hazards are hazards that are routinely encountered in general industry and construction; for these, national consensus codes and/or standards, such as Occupational Safety and Health Administration (OSHA) standards, exist to guide safe design and operation. The occupational hazards are evaluated as they pertain to the D&D activities at TAN-616 and are identified for further discussion if the hazard is applicable to the D&D project for TAN-616.

Table 2-1. Material and energy hazard identification checklist for the D&D of TAN-616.

Hazard	Applicable	Hazard Source(s)	Concern
Electrical energy	Yes	Electrical power to equipment	Potential electrical shock or fire hazard
Explosive materials	No	N/A	N/A
Fissile materials	Yes	U-235 contained in the residual materials	Criticality is not a concern for this activity, see Section 2.2.1.4.2.
Flammable materials	Yes	Combustible material in the form of absorbents, waste liners, wooden waste boxes, and containment materials (wood and plastic)	Potential fire hazard
Hazardous materials	Yes	Metals (cadmium, chromium, lead, etc), organics (trichlorethene, carbon tetrachloride, etc), polychlorinated biphenyls (PCBs), and asbestos. Reactive materials (sodium hydroxide and sulfuric acid).	Potential exposure to personnel; however, these materials will be removed as part of the D&D activity.
Kinetic energy	Yes	Large pieces of demolition debris will be generated and construction equipment will be used during the D&D activities	Potential for personnel injury. Cut-off saws, nibblers, hydraulic shears, scabblers, hydraulic hammer, concrete saws and like equipment may be used by D&D to cut and remove systems and associated components or to remove contamination from the walls and floors.
Potential energy	Yes	Loads from cranes or equipment during removal activities	Potential for impact with other materials resulting in release or injury to personnel
Pressure	Yes	The hydraulic shears operate at pressures up to 1,500 psig. Various compressed gas cylinders may be located and used at the facility and/or used by D&D.	Potential personnel injury
Vacuum	No	N/A	N/A
Radioactive materials	Yes	Residual materials contain radioactive material. The predominant isotopes are Cs-137, Co-60, Sr-90, and U-235.	Potential for direct radiation exposure and exposure to radioactive contamination; however, these materials will be removed as part of the D&D activity.
Radiation	Yes	Radiation levels from the residual materials are present	Potential for direct radiation exposure
Thermal energy	Yes	Welding and cutting torches	Potential exposure to personnel due to release of radioactive and hazardous material
External events	No	N/A	N/A
Natural phenomena	Yes	Earthquake	Potential for direct radiation and contamination exposure
Other	No	N/A	N/A

Table 2-2. Occupational hazard analysis checklist for the D&D of TAN-616.

Hazard	Applicable to Facility (Y/N)	DOE-prescribed Program and OSHA Standards
High voltage (≥ 600 V)	No	N/A
Low voltage (< 600 V)	Yes	29 CFR 1910 Subpart S; NEC 70
Volatile flammable or reactive gases or liquids	Yes	29 CFR 1910 Subpart H, .144, .1200; 29 CFR 1926.152
Explosive materials	No	N/A
Cryogenic systems	No	N/A
High temperature (≥125°F at contact or 203°F water)	No	N/A
High pressure (≥25 psig for gas or vapor or ≥200 psig for liquids)	Yes	ASME Boiler and Pressure Vessel Code, American National Standards Institute/American Society of Mechanical Engineers Standard B31
Low pressure	No	N/A
Inert and low-oxygen atmospheres	Yes	29 CFR 1910.120, .1200; 29 CFR 1926.651
Toxic materials	Yes	29 CFR 1910.120, .1200, Subpart Z; 29 CFR 1926.353; American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs)
Nonionizing radiation	No	N/A
High intensity magnetic fields	No	N/A
High noise levels	Yes	29 CFR 1910.95, .1200; 29 CFR 1926.52; ACGIH TLVs
Mechanical and moving equipment dangers	Yes	29 CFR 1910.147, .211 through 222; 29 CFR 1910 Subparts O, P, Q; 29 CFR 1926 Subpart W
Working at heights	Yes	29 CFR 1910.25, .28; 29 CFR 1926.951, .451
Excavation	Yes	29 CFR 1926 Subpart P
Material handling dangers	Yes	29 CFR 1910.120, .176 through .182; 29 CFR 1926.953; DOE-STD-1090 Hoisting and Rigging
Material transportation	No	N/A
Pesticide use	No	N/A
Temperature extremes	Yes	29 CFR 1910.120, .1200; ACGIH TLVs
Inadequate illumination	No	N/A
Construction	No	N/A
Ionizing radiation	Yes	Radiation Protection Program, 10 CFR 835
Reactive materials: alkali metal/ corrosives	Yes	Chemical Safety Program DOE Order 5480.4; 29 CFR 1910.1200, .1450
Structural or natural phenomena	Yes	DOE Order 420.1, DOE-ID AE Standards, DOE G 420.1-2, 29 CFR 1910.119, Subpart E
Fire	Yes	Fire Protection Program, DOE Order 420.1

Table 2-2 (continued).

Hazard	Applicable to Facility (Y/N)	DOE-prescribed Program and OSHA Standards
Biological agents	Yes	None of the DOE-prescribed standards clearly address biological agents; however, 42 CFR 72.6 and 32 CFR 627 should be adhered to
Other	Yes	29 CFR 1903.1 (General Duty Clause)

2.1.1.3 Hazard Classification. The D&D of TAN-616 is classified as a low-hazard facility per DOE-ID O 420.D and categorized as a radiological facility based upon guidance in DOE-EM-STD-5502-94 and approved by DOE-ID (Stallman 2001).

2.1.1.4 Hazard Evaluation Results. Tables 2-1 and 2-2 provide the results of the hazard evaluation for the hazards identified as applicable for the D&D project at TAN-616. The hazards identified for further evaluation include all applicable hazards. The applicable hazards identified are:

- Electrical energy/low voltage
- Fissile materials
- Flammable materials
- High pressure
- Inert and low-oxygen atmospheres
- Toxic and hazardous materials
- Kinetic energy/mechanical and moving equipment
- High noise levels
- Working at heights
- Excavation
- Potential energy/material handling dangers
- Temperature extremes
- Ionizing radiation/radioactive material
- Reactive materials: alkali metal/corrosives
- Structural and natural phenomena

- Fire
- Biological agents
- Other.

2.1.1.4.1 Electrical Energy/Low Voltage—Low voltage, classified as less than 600 volts, will be in use at the D&D worksite. All building utilities will be isolated and either temporary power or power from portable generators will be in use. Electrical equipment and tools may pose shock or electrocution hazards to personnel. Safe-work practices must be implemented to prevent electric shock or other injuries resulting from direct or indirect electrical contact. When conducting work on energized or operating systems, workers will comply with lockout/tagout requirements. In addition, all electrical work will be reviewed and completed under the appropriate work controls (i.e., safe work permits, work orders).

Where applicable, out-of-service tags will be used at TAN-616. Out-of-service tags may be used to prohibit operation of equipment when there is no danger to personnel. Before beginning any surface penetrations or wall penetrations, utility clearances must be obtained by contacting telecommunications. A subsurface investigation clearance will be obtained in accordance with the *INEEL Maintenance Manual*, MCP-151, "Subsurface Investigations."

2.1.1.4.2 Fissile Materials—The evaluation presented in the *Hazard Assessment for the Decontamination and Dismantlement of the TAN-616 Liquid Waste Treatment Facility* (INEEL 2001d) concluded that, at the most, 187 g of U-235 could be present in the TAN-616 facility. This mass is in a form that can not go critical.[a]

2.1.1.4.3 Flammable Materials—Gasoline and diesel fuel that may be used at the task site for generators and other equipment will be stored, handled, and used according to INEEL procedures. Only approved flammable liquid containers, properly labeled with the content, will be used to store fuel. All fuel containers will be stored at least 15 m (50 ft) from any facilities (including project trailers) and ignition sources or stored inside an approved flammable storage cabinet. Additional requirements are provided in the *INEEL Safety and Health Manual*, MCP-584, "Flammable and Combustible Liquid Storage and Handling." Portable motorized equipment such as generators and light plants will be shut off and allowed to cool down in accordance with the manufacturer's operating instructions, prior to refueling, to minimize the potential for a fuel fire. Refueling tasks will be conducted only by qualified personnel.

2.1.1.4.4 High Pressure—There is a potential for personnel injury when operating the hydraulic shears at the TAN-616 project site. The shears operate at pressures up to 1,500 psig. The shears will be operated in accordance with the manufacturer's operating instructions and will be operated only by qualified operators.

Another hazard involving high pressure is the use of compressed gas cylinders. When handling or moving compressed gas cylinders, personnel will transport cylinders in the upright position and label containers properly and the cylinder cap should also be installed prior to moving. PRD-5040, "Handling and Use of Compressed Gases," details how compressed gases will be used and handled. Persons responsible for or working in the area where compressed gases are handled or used shall be instructed on

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a. M. N. Neeley, Interoffice memo to R. W. Jones, "Criticality Safety of TAN-616 Liquid Waste Treatment Facility," MNN-06-2001, August 9, 2001.

the gas's associated hazards, chemical and physical properties, necessary precautions, protective equipment, and emergency response procedures as per MCP-2715, "Hazard Communication."

2.1.1.4.5 Inert and Low-Oxygen Atmospheres—Work in confined spaces (such as the evaporator pit) may subject personnel to risks involving engulfment, entrapment, oxygen deficiency, and toxic atmospheres. A confined space entry permit and/or atmospheric monitoring shall be required before an employee can enter a confined space in accordance with the *INEEL Safety and Health Manual*, MCP-2749, "Confined Spaces."

If a suspected confined space is discovered and not properly posted, it will be treated as a permit-required confined space, until a determination is made by the project industrial hygienist (IH). Entrances must be posted with the required sign per MCP-2749.

2.1.1.4.6 Toxic and Hazardous Materials—The following paragraphs discuss the hazardous materials found during the 2000/2001 characteristic activities (INEEL 2001c). Also included are the concentration of the contaminants, a comparison with the regulatory levels, and how the hazard will be handled during the D&D activities.

Chromium was found above Resource Conservation and Recovery Act (RCRA) characteristic regulatory levels in the green paint found on the water tank. The chromium concentration was 54.6 mg/L. The regulatory level is 5.0 mg/L. The project IH will identify controls and personal protective equipment (PPE) requirements on the applicable safe work permit (SWP) to help prevent chromium exposure.

The evaporator pit sump sediment was found to contain cadmium above RCRA characteristic regulatory levels during the 2000/2001 characteristic activities (INEEL 2001c). The cadmium concentration was 1.36 mg/L and the regulatory level for the toxicity characteristic is 1.0 mg/L. Personnel must follow procedures as applicable and as outlined in MCP-2721, "Controlling and Monitoring Exposures to Cadmium." If the project IH determines that cadmium is a health hazard, personnel may be required to have additional training and/or additional PPE.

Polychlorinated biphenyls (PCBs), particularly Aroclor-1260, are present at the TAN-616 site. The paint throughout the building contains PCBs above regulatory levels per the Toxic Substances Control Act (TSCA). The sediments found in the head tank and pump room sump also contained PCBs above the regulatory level (50 parts per million or 50 mg/kg). Polychlorinated biphenyl concentrations varied from 56 mg/kg in the head tank sediment to 35,000 mg/kg in the paint from the operating pump room (INEEL 2001c). Personnel must use the proper PPE as advised by the IH.

Waste residues remaining in the TAN-616 head tank (V-5) and building sumps (evaporator pit sump and pump room sump) are considered RCRA F001 listed waste for trichlorethene (TCE). Portions of the pump room and evaporator pit have been contaminated by releases of F-listed waste. Trichlorethene may cause heart, liver, and kidney damage as well as irritation of the respiratory tract and skin; however, concentrations in TAN-616 are very low (less than 1 ppm). Project personnel will wear appropriate PPE, which may include respiratory protection, when working near possible contamination sources. The project IH will advise workers on the health risks posed by TCE and implement controls to prevent exposure.

Other volatile organic compounds, such as methylene chloride, 2-butanone, toluenes, and ethylbenzene, were found during the 2000/2001 characterization activities (INEEL 2001c). These compounds were found in the pump room and evaporator pit and the concentrations are very low (less than 1 ppm). These compounds are skin and eye irritants that may affect the nervous system in prolonged exposures. Project personnel will wear appropriate PPE, which may include respiratory protection when

working near possible contamination sources. The project IH will advise workers on the health risk of these compounds and implement controls to prevent exposure.

Lead compounds are present at the TAN-616 task-site. The primary source of lead is the approximately 25 lead sheets at the bottom of the evaporator pit. The lead sheets were used as shielding for the operators during facility operations. The constant air monitors contain lead that was used to shield the detectors. The sediment in the evaporator pit sump, the material on the floor beneath the evaporator, and the liquid from the caustic tank pump suction line contain lead above RCRA characteristic regulatory levels (INEEL 2001c). The lead concentrations varied from 5.79 mg/L in the pump room sump sediment to 34.5 mg/L in the evaporator sediment. The regulatory level for the toxicity characteristic is 5.0 mg/L. Controls for work with and around lead are necessary to ensure worker health and safety. These controls include training, medical surveillance, and PPE. Personnel must follow applicable procedures as outlined in the *INEEL Safety and Health Manual*, MCP-2720, "Controlling and Monitoring Exposures to Lead."

Asbestos material is present at the TAN-616 site in insulation and other building components. Personnel must be aware of asbestos hazards and the dangers of asbestos exposure and must take proper precautions to prevent exposure to the worker, the public, and the environment. Asbestos fibers can cause cancer and lung disease. Personal protective equipment must be worn during removal operations if the worker will come in contact with suspected asbestos material or if a potential exists for airborne asbestos fibers. The PPE may include respirator protection. Specific safe-work practices, engineering controls, and other requirements must be satisfied to mitigate personnel exposure risks and to ensure worker health and safety. Personnel should follow proper procedures, as outlined in the *INEEL Safety and Health Manual*, MCP-2862, "Asbestos Management Program Administration," MCP-2859, "Posting Asbestos Advisory Signs," and other applicable MCPs and technical procedures.

Table 2-3 presents the highest concentrations of metals and PCBs found in the head tank (V-5), evaporator pit sump, pump room sump, and water tank. Table 2-4 presents the total inventory of material that may be found in each of the same areas based on an estimated volume of material. The hazard assessment (INEEL 2001d) provides a complete evaluation of these areas. Additionally, the process piping line (104-A2-6") from tank V-9 to the feed header for tanks V-1, V-2, and V-3 enters the TAN-616 building in the pump room. The contents of this line and tanks V-9, V-1, V-2, and V-3 are covered under the TAN Operations Safety Analysis Report (INEEL 2001a). Tanks V-9, V-1, V-2, and V-3 are all located to the east of the TAN-616 building. The material (radioactive and hazardous) in the head tank (V-5) and sumps is a product of tanks V-9, V-1, V-2, and V-3.

Table 2-3. Highest hazardous material concentrations found in TAN-616.

Compound	Head Tank (V-5) (μg/L)	Evaporator Pit Sump (μg/L)	Pump Room Sump (μg/L)	Water Tank (V-11) (μg/L)
Arsenic	0.00E+00	1.64E+02	0.00E+00	0.00E+00
Barium	6.83E+02	2.81E+02	1.54E+03	1.27E+03
Cadmium	1.50E+02	1.36E+03	2.05E+02	0.00E+00
Chromium	9.76E+02	9.20E+02	1.36E+01	3.90E+01
Lead	0.00E+00	7.12E+03	5.79E+03	0.00E+00
Mercury	6.59E+01	9.41E+01	6.33E+01	0.00E+00
Selenium	0.00E+00	4.96E+01	0.00E+00	0.00E+00
Silver	0.00E+00	7.78E+00	4.59E+00	4.59E+00
PCBs (Aroclor-1260[a])	6.20E+04	3.00E+04	1.50E+05	1.30E+03

a. Aroclor-1260 concentrations are in μg/kg.

Note: Organic compounds (other than Aroclor-1260) are also present; however, concentrations are less than 1 ppm and, therefore, not calculated as part of the hazardous material inventory.

Table 2-4. TAN-616 total quantities of hazardous material.

Compound	Head Tank (V-5) (kg)	Evaporator Pit Sump (kg)	Pump Room Sump (kg)	Water Tank (V-11) (kg)	Total Mass (kg)
Arsenic	0.00E+00	2.78E-05	0.00E+00	0.00E+00	2.78E-05
Barium	1.45E-04	4.77E-05	2.88E-05	1.47E-05	2.36E-04
Cadmium	3.18E-05	2.31E-04	3.83E-06	0.00E+00	2.67E-04
Chromium	2.07E-04	1.56E-04	2.54E-07	4.53E-07	3.64E-04
Lead	0.00E+00	1.21E-03	1.08E-04	0.00E+00	1.32E-03
Mercury	1.40E-05	1.60E-05	1.18E-06	0.00E+00	3.11E-05
Selenium	0.00E+00	8.42E-06	0.00E+00	0.00E+00	8.42E-06
Silver	0.00E+00	1.32E-06	8.57E-08	5.33E-08	1.46E-06
Aroclor-1260	1.97E-02	7.64E-03	4.20E-03	2.26E-05	3.16E-02

2.1.1.4.7 Kinetic Energy/Mechanical and Moving Equipment—The hazards associated with the operation of heavy equipment include injury to personnel, equipment damage, and/or property damage. All heavy equipment will be operated in the manner in which it was intended and according to manufacturer's instructions. Only authorized personnel will be allowed in the vicinity of operating heavy equipment and should maintain visual communication with the operator. Work-site personnel working with, around, or near heavy equipment and other moving machinery must comply with appropriate *INEEL Safety and Health Manual* MCPs including, MCP-2745, "Heavy Industrial Vehicles," and MCP-2743,

"Motor Vehicle Safety." When applicable, site personnel will also comply with DOE-STD-1090-99, "Hoisting and Rigging."

2.1.1.4.8 High Noise Levels—Some equipment used during the D&D activities may present a high noise hazard to personnel. The project IH will identify areas with the potential for high noise levels and monitor noise level for each work area per the requirements of MCP-2719, "Controlling and Monitoring Exposure to Noise." Personnel will follow the requirements of PRD-2108, "Hearing Conservation," which includes the Hearing Conservation Program requirements. If personnel are exposed to noise levels that may be at or above action levels, appropriate engineering controls shall be the first means of corrective action, and then administrative controls to reduce noise levels. If engineering or administrative controls are not effective or feasible, then PPE shall be used to reduce noise exposure.

2.1.1.4.9 Working at Heights—Equipment removal in several areas of TAN-616 will require utilization of elevated work platforms such as scissors lifts or articulated boom aerial lifts. Use of elevated work platforms will comply with the manufacturer's instructions and applicable INEEL procedures. Personnel will employ fall protection when exposed to any unprotected fall hazard of 1.8 m (6 ft) or more. Handrails or fall arrest systems may be used to mitigate fall hazards. Workers will use other fall protection devices where necessary and as required in work task documentation. Personnel will comply with the requirements of the *INEEL Safety and Health Manual*, PRD-5096, "Fall Protection."

2.1.1.4.10 Excavation—Excavations will occur at TAN-616 as part of the D&D activity. The building and the associated piping will be excavated for dismantlement purposes. Excavation activities and work in excavations shall be subject to the requirements in PRD-22, "Excavation and Surface Penetration." In addition, MCP-3002, "Managing Disturbed Soils," is required for planned disturbance, excavation, and subsequent management of disturbed/excavated soils. Personnel in an excavation shall be protected from cave-ins by an adequate protective system as described in Section 3.2 of PRD-22.

2.1.1.4.11 Potential Energy/Material Handling Dangers—The handling and maneuvering of various pieces of equipment and materials may result in employee injury. Manual material handling will be minimized through task design and use of mechanical and/or hydraulic lifts whenever possible. Workers must use proper lifting techniques when lifting heavy objects.

2.1.1.4.12 Temperature Extremes—The project activities will be conducted during months where there is a potential that both heat and/or cold stress factors could affect task site personnel. The potential is based on ambient air temperatures and layered PPE.

Outside temperatures are expected to be variable during the project, and personnel working in the building will be required to wear appropriate protective clothing. High ambient air temperatures can result in increased body temperatures, heat fatigue, heat exhaustion, or heat stroke that can lead to symptoms ranging from physical discomfort, to unconsciousness and even death. The *INEEL Safety and Health Manual*, MCP-2704, "Heat and Cold Stress," discusses the hazards and monitoring of heat stress. Depending on the ambient weather conditions, work conditions, type of PPE worn, and the physical response of work operations personnel, the safety professionals (i.e., IH) may require an adjustment to work/rest cycles.

Exposure to low temperatures is also possible during the project activities. Project personnel will be aware that relatively cool ambient temperatures, combined with wet or damp clothing and light breezes, increase the potential for hypothermic injury. The project IH will be responsible for obtaining meteorological information to determine whether additional cold stress requirements are needed. The *INEEL Safety and Health Manual*, MCP-2704, "Heat and Cold Stress," discusses the hazards and monitoring of cold stress.

2.1.1.4.13 Ionizing Radiation/Radioactive Material—The majority of the radiological inventory, direct ionizing radiation, and radioactive material is located in the evaporator pit and the pump room. Radiological control personnel performed surveys of the facility during the characterization activities in 2000/2001. General radiation levels in the evaporator pit ranged from 40 to 80 mR/hr gamma radiation. Contact readings ranged from 500mR/hr gamma radiation at the sump to 600 mR/hr gamma radiation on the lead shielding located in the evaporator pit. Contamination levels range from 2.18E+04 dpm/100 cm^2 beta/gamma and 21 dpm/100 cm^2 alpha on the floor near the evaporator (V-7) to 3.37E+05 dpm/100 cm^2 beta/gamma and 88 dpm/100 cm^2 alpha on the lead shielding. General radiation levels in the pump room ranged from 5 mR/hr gamma near the stairs to 30 mR/hr gamma at the P-1 pump. The only contact reading taken was on the P-1 pump (40 mR/hr gamma, 2,880 mR/hr beta/gamma). Contamination levels ranged up to 3.37E+05 dpm/100 cm^2 beta/gamma and up to 172 dpm/100 cm^2 alpha.

Table 2-5 provides the highest concentrations found during the characterization activities of 2000/2001 (INEEL 2001c) for radioactive material found in the head tank (V-5), evaporator pit sump, the pump room sump, water tank (V-11), smears (loose contamination on floors and walls) and in the facility piping. Table 2-6 provides a total quantity of radionuclides for each of the same areas based on an estimated volume of material. The hazard assessment (INEEL 2001d) provides a complete evaluation of these areas. The material (radioactive and hazardous) in the head tank (V-5) and sumps is a product of tanks V-9, V-1, V-2, and V-3.

2.1.1.4.14 Reactive Materials: Alkali Metal/Corrosives—Residual amounts of sodium hydroxide and sulfuric acid may be a hazard to personnel during D&D activities. Tanks and piping that held sodium hydroxide and piping and pumps that held sulfuric acid will be removed as part of the D&D activities. It is thought that only residual amounts remain in the piping, tanks, and/or pumps; however, personnel must practice safe work procedures in order to prevent exposure. Sulfuric acid and sodium hydroxide are eye irritants and may be extremely irritating, corrosive, and toxic to tissue. The exposure potential is considered low. If either compound is found it will be cleaned up under the direction of the project IH. The IH will identify controls and PPE requirements on the applicable SWP.

2.1.1.4.15 Structural and Natural Phenomena—The TAN-616 building has not been evaluated for resistance to natural phenomena hazards under current requirements. The building was constructed in 1955; however, the building is constructed of reinforced concrete and the walls range from 8 in. to 3 ft thick. A new roof was built over the existing roof in the fall of 1993. If a natural phenomena event did occur, it is thought that the building would still provide a shield against personnel exposures. The majority of the radiological and nonradiological inventory is located in the evaporator pit area of the building. The evaporator pit is 4 ft below grade and consists of 2- to 3-ft thick walls around an 8-in. slab-on-grade with a 4-in. thick beam-reinforced concrete roof. The remaining inventory is primarily in the pump room, which is 11 ft below grade with 6-in. thick slab-on-grade and 1-ft thick reinforced concrete walls and ceiling.

2.1.1.4.16 Fire—Restricting the combustible material within the facility in accordance with the INEEL Fire Protection Program and facility inspections minimizes fire hazards at TAN-616. Flammable and/or combustible liquids must be in appropriate containers and cabinets. Incompatible materials, including waste materials, must be segregated, as appropriate (away from ignition sources). Portable fire extinguishers will be strategically located at the site to combat Class ABC fires. Fire extinguishers will be located on or near site equipment that has exhaust heat sources, and on or near all equipment capable of generating ignition or having the potential to spark.

Table 2-5. Highest radionuclide concentrations found during characterization activities in TAN-616.

Isotope	Head Tank (V-5) (pCi/g)	Evaporator Pit Sump (pCi/g)	Pump Room (pCi/g)	Water Tank (V-11) (pCi/g)	Smear (pCi/sample)	Piping (pCi/g)
Ag-108m	9.44E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.18E+02
Ag-110m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.92E+03	0.00E+00
Am-241	9.08E+02	5.42E+01	5.52E+01	0.00E+00	2.59E+01	2.23E+02
Ba-137m	3.38E+06	8.44E+06	4.14E+06	3.52E+01	6.88E+04	4.57E+06
Co-60	1.01E+06	1.59E+04	1.05E+04	2.21E-01	1.62E+02	2.53E+05
Cs-134	0.00E+00	0.00E+00	3.92E+02	0.00E+00	0.00E+00	0.00E+00
Cs-137	3.57E+06	8.92E+06	4.38E+06	3.72E+01	7.27E+04	4.81E+06
Eu-152	2.30E+04	0.00E+00	7.78E+02	0.00E+00	1.43E+02	5.05E+03
Eu-154	7.48E+03	0.00E+00	0.00E+00	0.00E+00	6.31E+01	1.68E+03
Nb-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+01	6.86E+01
Pu-238	2.04E+03	3.30E+02	1.63E+02	0.00E+00	2.21E+01	6.11E+02
Pu-239/240	5.49E+03	2.71E+02	2.54E+02	0.00E+00	6.90E+01	1.36E+03
Sr-90	5.15E+06	8.73E+05	3.07E+05	1.59E+01	4.51E+04	1.52E+06
U-234	2.68E+04	2.79E+03	8.16E+02	0.00E+00	5.46E+01	7.10E+03
U-235	1.05E+03	1.21E+02	3.38E+01	0.00E+00	3.67E+01	2.96E+02
U-238	5.73E+02	4.09E+01	1.38E+01	0.00E+00	8.45E-01	1.57E+02
Y-90	5.15E+06	8.73E+05	3.07E+05	1.59E+01	4.51E+04	1.52E+06
Zn-65	2.19E+04	0.00E+00	0.00E+00	0.00E+00	2.04E+01	2.74E+03

Table 2-6. TAN-616 total quantities of radionuclides.

Isotope	Head Tank (V-5) (Ci)	Evaporator Pit Sump (Ci)	Pump Room (Ci)	Water Tank (V-11) (Ci)	Piping (Ci)	Smear (Ci)	Total (Ci)
Ag-108m	3.01E-04	0.00E+00	0.00E+00	0.00E+00	1.30E-05	0.00E+00	3.14E-04
Ag-110m	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.00E+00	1.33E-04	1.331E-04
Am-241	2.89E-04	1.38E-05	1.55E-06	0.00E+00	2.45E-05	1.79E-06	3.31E-04
Ba-137m	1.08E+00	2.15E+00	1.16E-01	6.13E-07	5.03E-01	4.77E-03	3.85E+00
Co-60	3.22E-01	4.05E-03	2.94E-04	3.85E-09	2.78E-02	1.12E-05	3.54E-01
Cs-134	0.00E+00	0.00E+00	1.10E-05	0.00E+00	0.00E+00	0.00E+00	1.10E-05
Cs-137	1.14E+00	2.27E+00	1.23E-01	6.47E-07	5.29E-01	5.04E-03	4.07E+00
Eu-152	7.32E-03	0.00E+00	2.18E-05	0.00E+00	5.56E-04	9.91E-06	7.91E-03
Eu-154	2.38E-03	0.00E+00	0.00E+00	0.00E+00	1.85E-04	4.37E-06	2.57E-03
Nb-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.55E-06	6.93E-07	8.24E-06
Pu-238	6.49E-04	8.41E-05	4.57E-06	0.00E+00	6.72E-05	1.53E-06	8.07E-04
Pu-239/240	1.75E-03	6.90E-05	7.12E-06	0.00E+00	1.50E-04	4.78E-06	1.98E-03
Sr-90	1.64E+00	2.22E-01	8.60E-03	2.77E-07	1.67E-01	3.13E-03	2.04E+00
U-234	8.53E-03	7.11E-04	2.29E-05	0.00E+00	7.81E-04	3.78E-06	1.01E-02
U-235	3.34E-04	3.08E-05	9.47E-07	0.00E+00	3.26E-05	2.54E-06	4.01E-04
U-238	1.82E-04	1.04E-05	3.87E-07	0.00E+00	1.73E-05	5.86E-08	2.11E-04
Y-90	1.64E+00	2.22E-01	8.60E-03	2.77E-07	1.67E-01	3.13E-03	2.04E+00
Zn-65	6.97E-03	0.00E+00	0.00E+00	0.00E+00	3.01E-04	1.41E-06	7.28E-03

2.1.1.4.17 Biological Agents—The site is located in an area that provides habitat for various rodents, birds, insects, and reptiles. Based on biological studies done at the INEEL, deer mice have been known to carry the Hantavirus. The virus is present in the nesting and fecal matter of deer mice. A potential exists for project personnel to disturb nesting or fecal matter during the course of the D&D activities. If such materials are disturbed, they can become airborne and create a potential inhalation pathway for the virus. Also, contact and improper removal of these materials may provide additional inhalation exposure risks.

If suspect rodent nesting or excrement material is encountered, a SWP will be written for disinfection and removal of the material from the task area. The IH will provide the necessary guidance for PPE, mixing and application of the disinfecting solution (bleach solution), and proper waste disposal methods.

Snakes, spiders, ticks, mosquitoes, and other insects may also be encountered at the project site. Common areas of concern include material stacking/staging areas, under existing structures (trailers or buildings), under boxes, and in other areas that provide shelter. Protective clothing will prevent insects from direct contact with personnel.

2.1.1.4.18 Other—The general duty clause requires employers to furnish a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm to employees. The Occupational Safety and Health Act of 1970 also requires employers to comply with occupational safety and health standards and that employees comply with standards, rules, regulations, and orders issued under the Act which are applicable to their own actions and conduct. The purpose of 29 CFR 1903 is to prescribe rules and to set forth general policies for enforcement of the inspection, citation, and proposed penalty provisions of the Act.

3. HAZARD CONTROLS

Industrial safety hazards pose a significant threat at the task site. Many of the hazards associated with the D&D activities are standard industrial hazards and may involve only a small portion of radiological and nonradiological (toxic and/or hazardous materials) inventory available at the TAN-616 facility. Table 2-2 includes the DOE-prescribed program and OSHA standards for all hazards considered standard industrial hazards. The specific industrial safety hazards and their associated company procedures that help eliminate or minimize the potential hazards to project personnel have been described in Section 2.

The potential for exposure to radiological and nonradiological hazards exists during many of the tasks that will take place at the TAN-616 work site and may affect all personnel at the work site. As shown in Section 2 the total inventory is quite low. The use of work control zones, engineering and administrative requirements, worker training, and protective equipment will mitigate these hazards to a large degree. In addition, monitoring with direct reading instruments may be conducted to provide radiological control and IH personnel with real-time data to assess the effectiveness of project controls.

Potential exposure to hazardous and radiological materials exists from the presence of lead, chromium, cadmium, asbestos, PCBs, TCE, fixed and loose radiological contamination, and direct radiation. The IH and radiological control personnel will monitor with direct reading instrumentation, contamination surveys, and full and partial period air sampling in accordance with the applicable technical procedures, as deemed appropriate.

3.1 Industrial Hygiene Monitoring

Various direct reading instruments and other detection tests will be utilized to determine the presence of nonradiological and other physical agents. The frequency and type of sampling and monitoring will be determined by changing site conditions, direct reading instrument results, observation, and professional judgement. Instruments and sampling methods will be used by the project IH as deemed appropriate.

All full and partial period airborne contaminant sampling may be conducted using applicable NIOSH or OSHA methods and in conformance to the *INEEL Safety and Health Manual*. Risk assessments for site personnel will be conducted according to the *INEEL Safety and Health Manual*, MCP-153, "Industrial Hygiene Exposure Assessment."

3.2 Radiological Monitoring

During project tasks, the potential exists for exposure to low-level radioactive contamination and direct radiation during D&D activities. Radiological monitoring at the task site will be performed in accordance with the applicable requirements of the *INEEL Radiological Control Manual*, and MCP-139, "Radiological Surveys," MCP-425, "Surveys of Materials for Unrestricted Release and Control of Movement of Contaminated Material," and MCP-357, "Job-Specific Air Sampling/Monitoring," as well as other INEEL requirements and procedures.

3.2.1 Radiation Monitoring

Since external radiation sources exist throughout the building, including elevated levels in the solids and potential exposure to surface contamination, personnel monitoring methods will be used. Monitoring may include the use of direct reading radiation detectors (ion chambers, Geiger-Mueller, etc.),

thermoluminescent dosimeters, and electronic dosimetry, as described on the radiological work permit. Monitoring data will be used by radiological control personnel to evaluate the effectiveness of engineering controls, ensure work zone boundaries are adequate, alert project personnel to potential high radiation sources, and ensure the effectiveness of decontamination methods and procedures.

3.2.2 Radioactive Contamination Monitoring

The greatest potential for radiological contamination will be from the residual materials left within the facility building, particularly in the evaporator pit area. Contamination is of particular concern because of its mobility, difficulty in detection, and possibility of cross-contamination. Contamination monitoring for alpha and beta-gamma radioactive contamination will be accomplished using extensive survey and smear collection techniques. Radiological control personnel will evaluate the effectiveness of engineering controls, ensure that radiological are boundaries are adequate, alert project personnel to avoid contaminated areas, and ensure the effectiveness of personnel and equipment decontamination procedures.

3.3 Radiological Control/Industrial Hygiene Exposure Assessment

To prevent and mitigate potential personnel exposure to radiological, nonradiological, and physical hazards at the site, action levels (ALs) are established in the task-specific health and safety plan (HASP) (INEEL 2000). If ALs are reached, personnel will take the appropriate actions as listed in the HASP.

Health and safety plans are required for all hazardous waste activities as defined in 29 CFR 1910.120 as mandated by DOE Order 5480.4, "Environmental Protection, Safety, and Health Protection Standards." Section 8 of the HASP addresses limiting personnel exposures to radiological, chemical, and industrial hazards. The inventory of radioactive and hazardous materials will be decreasing during the D&D activities of the building and its contents. Personnel monitoring and control of physical hazards will be continually performed during the D&D activities. The monitoring tasks and control of hazards will be performed in accordance with applicable company requirements.

3.4 Administrative Controls

To prevent inadvertent opening of the feeder header valves, the valve handles for the feed lines (feed header valves for V-1, V-2, and V-3 process piping line 104-A2-6") must be removed and the valves locked out of service. This will include removing the manual actuator extension rods and employing a clamshell-type lock mechanism. Before the material from the V-9 tank can be removed, the effluent line from V-9 must be physically isolated (e.g., cut and capped) from TAN-616.

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